SIGHTINGS

A Terabyte of a Twister

Felice Frankel

Donna Cox is a professor and the director of visualization and experimental technologies at the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign, where she oversees the animation, coloring and design of various simulation projects. Her collaborators on this project were Robert Patterson, Stuart Levy, Alex Betts and Matthew Hall (visualization); and Robert Wilhelmson, Matthew Gilmore, Louis Wicker, Glen Romine, Lee Cronce and Mark Straka (simulation).

F. F. The triangular shapes on the surface seem to indicate a directionality. Am I reading that correctly?

D.C. A new "glyph" was developed for this project. The triangular shapes on the surface of the ground are three-dimensional cones—a visual representation adapted from conventional vectors made with black and white line plots. The cones indicate direction of the air at the ground. In addition, these glyphs provide two more pieces of information: They use color to indicate temperature, and the strength of the wind is indicated by their tilt. This is analogous to seeing wheat grass blow in the wind: You can see how hard the wind is blowing by how flat the grass is pushed (or tilted).

F. F. Can you explain the color choices? For example, I notice that orange appears in the tubes and also in the triangular surface forms. Was that intended to show a correlation or was it purely an aesthetic choice?

D.C. "Cool" colors in the cyan-blue-purple range and "warm"colors, red-yellow-brown, are used for indicating temperature. In general, cool temperatures are indicated by bluish colors and warm temperatures by reddish colors. Aesthetic decisions control the levels, saturations, shades and intensities. The cool colors of the cones and streamtubes are both representing cool temperatures in the air.

The spherical particles are colored according to pressure. The redder they are, the higher the pressure. The streamtubes are colored by temperature, with a sharp divide between cool and warm. Finally, the color of the cones also has a divide between cool and warm air, but the cones have a slightly different saturation level to stand out from the colors used on the streamtubes.

F. F. Did you test various color palettes before you came up with this final version?

D.C. We tested many versions of the color-transfer functions that are the "color maps" used here. We tested color intensity, value, saturation, luminosity, translucency and color temperature. These color maps were determined to help show a difference between the surface and the air temperature. They were also developed while working with the scientists.

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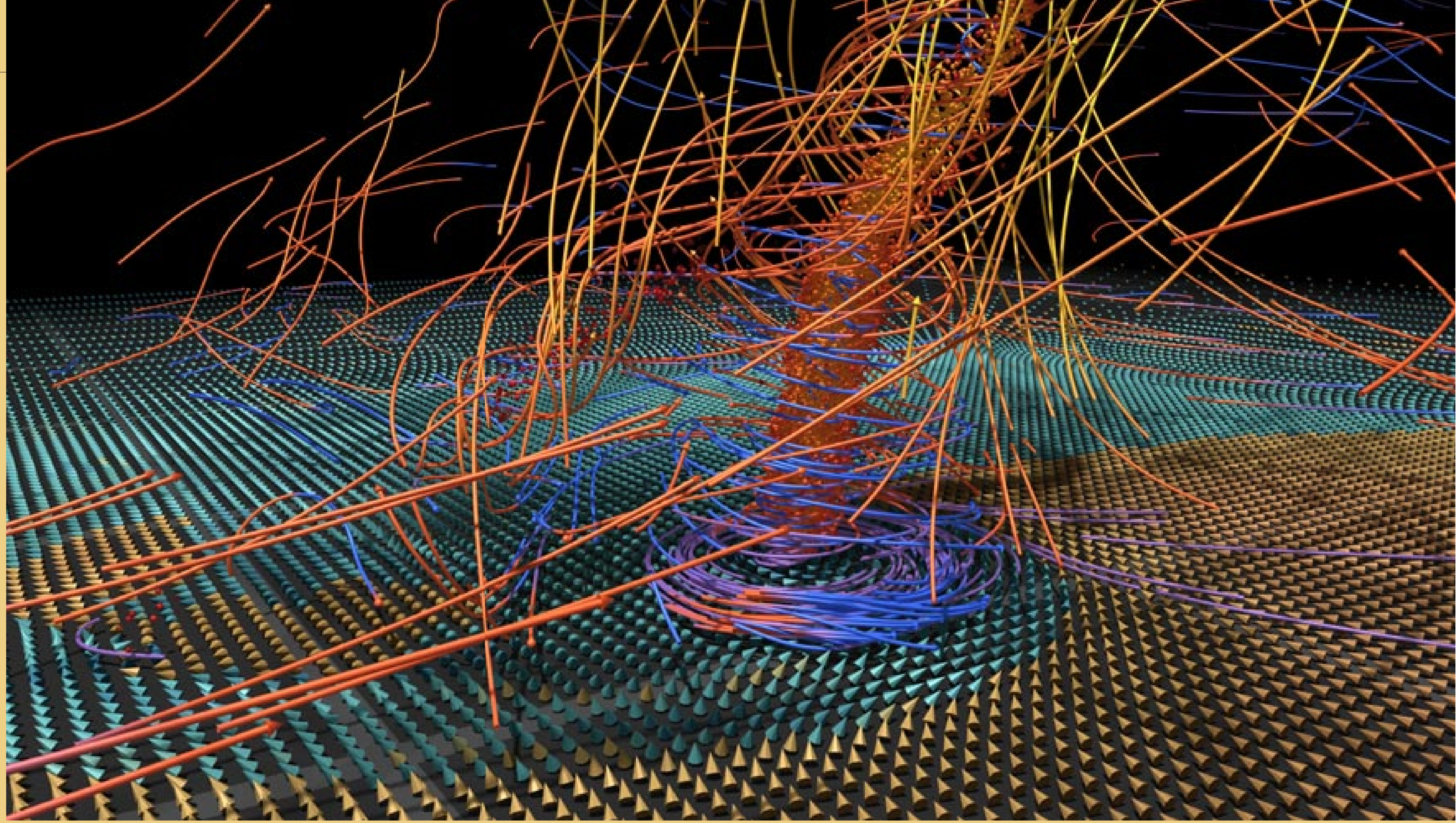


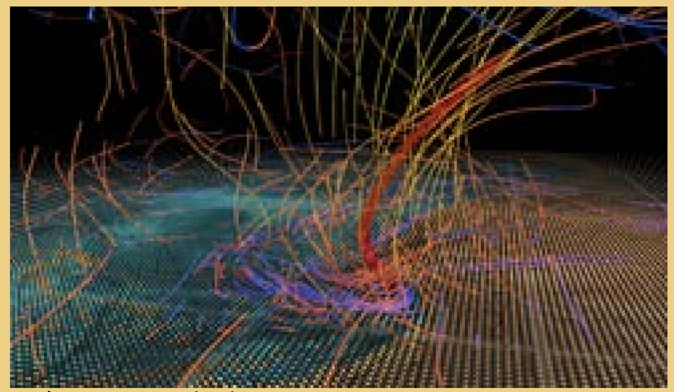
mid-storm

F. F. I wonder if you see a benefit to reading this simulation frame by frame, along with the dynamic version.

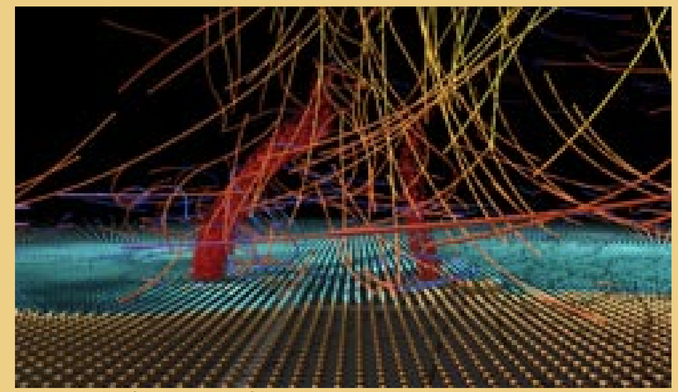
D.C. The ability to study a frame-by-frame image sequence as still frames in addition to seeing the time-evolving animation is the best combination for study and understanding of data. While the animation provides a qualitative, dynamic motion study, I think that being able to study a time sequence frame by frame provides a different level of information and enhances the understanding of the overall interaction.

F. F. What do you find is the biggest challenge in collaborating with scientists while making these representations?

D.C. The biggest challenge in collaborating with scientists is overcoming differences in language and vocabulary. Visualization experts have definitions for "features" that may or may not always fit with a scientist's definition. Finding common ground on how to explain concepts using language and pictures is the biggest challenge.



early storm: organization



late storm: formation of daughter vortex

Snapshots from a time-evolving animation produced by the National Center for Supercomputing Applications show the geometry of airflow around a developing tornado within a simulated severe storm. The simulation—created by calculating the motion of "invisible weightless particles" beginning with a set of initial conditions from a real storm—was developed from over a terabyte of raw simulation data that yielded an equally large volume of simulation data, represented by graphic elements called "glyphs." The glyphs include "stream tubes," "spherical particles" and "surface cones." Some of the first three-dimensional glyphs for dynamic data-driven visualizations were developed in 1988 in collaboration with a Kodak research scientist; they have become standard visual representations in off-the-shelf software from Advanced Visual Systems and other manufacturers. The NCSA group modified the standard and created new glyphs. (Images courtesy of NCSA and the University of Illinois at Urbana-Champaign.)

Resource: Making Science and Engineering Pictures: A Practical Guide to Presenting Your Work
Felice Frankel